

Mobility Analysis for the Digitized Brigade

by Captain Robert S. Mikaloff

Today's emphasis on achieving unprecedented levels of situational awareness by digitization of the battlefield and visualization skills of battle command requires a greater knowledge of terrain than in the past. New and sophisticated weapons, sensors, and command and control methods demand detailed information for employment. The ability to gather and understand information about the terrain is critical to our success.

ST 71-3, *Tactics Techniques and Procedures for the Digitized Brigade* outlines the importance of more precise terrain products to a digitized force, given the nature of its operations: "The brigade must integrate its combat power at the right time and place to achieve the effects required to accomplish the mission and protect the force." Listed as a capability critical to the integration of the force is a "movement rate program" able to predict rates of movement of subordinate units along independent approaches.

During the 1995 Armor Conference, the Army Corps of Engineers Waterways Experiment Station displayed automated mobility prediction software that can provide this information; it is called Risk Based Mobility Modeling. The focus of this model is on ground mobility. It examines how various factors, such as soil composition, slope, and precipitation, relate to terrain data for any given area. Risk Based Mobility Modeling can provide mobility estimates with a level of accuracy, detail, and precision impossible to achieve through manual terrain analysis. The program can be applied to movement of enemy forces or planning the movement of friendly forces.

At brigade and task force levels, the formal process of terrain analysis traditionally belongs to the S2. It is a familiar sight to see S2s bent over a map, circling terrain features and making an educated guess about the trafficability of terrain. Through a map analysis, the S2 seeks to define if the terrain is trafficable at all, where vehicles are likely to be able to go, and how long it will take to move through certain areas. An automated mobility prediction capability, such as Risk Based Mobility Modeling, will increase the quality and

quantity of terrain information and speed its production. By reducing time used to classify terrain (severely restricted, restricted, or unrestricted), more time is available to analyze the significance of terrain relative to enemy and friendly force tactical situations.

Currently, an automated terrain analysis capability is available to commanders at division level. This resides at the Division Topographic Engineer Detachment. The Topographic Engineer Detachment supports the entire division, and has adequate conventional systems to aid in terrain visualization. There are several factors that limit the adequacy of this support to meet future needs.

Operations other than war, force protection operations, and other diverse requirements generated by the end of the cold war increased the burden on division topographic teams. With this increased workload, the Division Topographic Detachment cannot adequately answer the brigade commander's requirements in a timely fashion while still responding to the needs of the division commander.

The Topographic Engineer Detachment supports the entire division. At brigade or task force level, getting topographic support involves making a request through intelligence channels to the G2. Once a request is in the queue, the G2 sets the detachment's priorities. The increased operational tempo of digitized forces requires that terrain analysis be responsive and timely. If your request is not high on the priority list, the support you get will be late in coming, probably too late for your purpose. Once again, the S2 will be left in the corner drawing lines on a map and making a guess on terrain. A solution is giving the brigade S2 an automated terrain analysis capability that addresses one of his, and his commander's, principal concerns — mobility.

The All Source Analysis System (ASAS) WARLORD, projected to be fielded to brigades, has limited terrain analysis capabilities. The map and terrain tools currently resident on ASAS WARLORD are Digital Feature Analysis Data (DFAD) and Digital Terrain Elevation Data (DTED). DFAD provides information on natural and man-

made features, such as vegetation, soil composition, roads, drainage, and urban areas. DTED provides elevation data. Both are good tools to aid a commander in terrain visualization and provide some baseline information needed to perform mobility analysis. However, these applications cannot integrate this information into mobility predictions. To adequately meet the needs of the commander, the brigade requires a mobility prediction tool, like Risk Based Mobility Modeling, that can merge all variables that affect mobility.

The Risk Based Mobility Model is a UNIX-based system potentially compatible with the ASAS, being fielded to divisions, and ASAS WARLORD, projected to be fielded at the brigade level. It complements the capabilities of DFAD and DTED. With DFAD and DTED, the S2 has information on the characteristics of the area. Risk Based Mobility merges the type of information found on DFAD and DTED with information on soil composition, precipitation, etc., into predictions useful for intelligence, tactical maneuver, fire planning, and battlefield logistics.

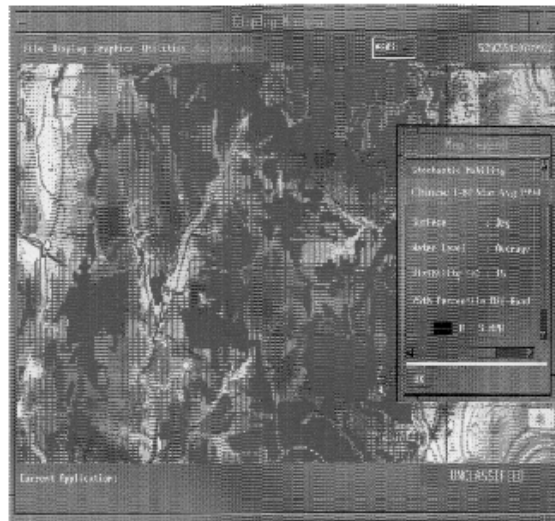
The capabilities of Risk Based Mobility Modeling include standard IPB products, such as identification of unrestricted, restricted, or severely restricted terrain. These are principal considerations for Phase II of the IPB process, "Describe the Battlefield's Effects," and a major element in the development of the Modified Combined Obstacle Overlay (MCOO). Risk Based Mobility Modeling can further define trafficability based on the type of vehicle, (i.e., areas where tracked vehicles can move).

Risk Based Mobility can take this a step further. Mobility analysis can be tailored to specific characteristics of enemy and friendly vehicles and formations (see Figure 1). In addition to identification of unrestricted, restricted, or severely restricted terrain, Risk Based Mobility Modeling can render a prediction of the speed at which specific vehicles can traverse an area. Figure 2 illustrates cross country speed for an M1A1.

Other mobility studies analyze terrain based on homogeneous soil composition. The Risk Based Model compen-

AREA: KOREA VEHICLE: M1A1

VEHICLE: THREAT VEHICLE



Solid = Conclusive NOGO.

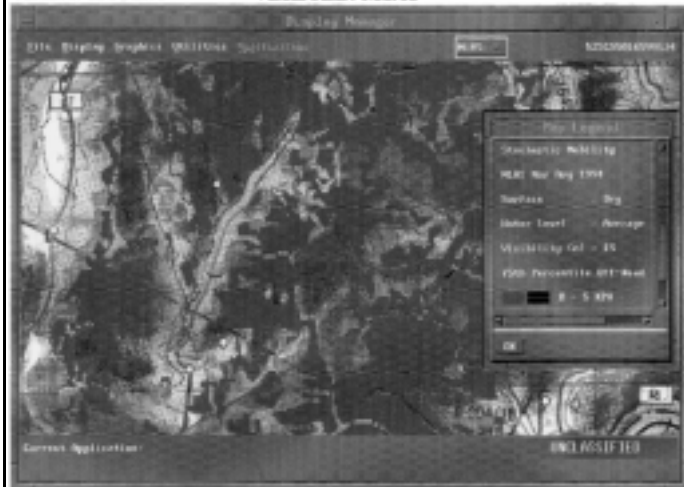
Hatched = Not Recommended For Travel; May Possibly Navigate With Difficulty

Figure 1

These illustrations are intended to give readers a feel for the screen formats of the mapping system. Many of the fine details visible in the actual color versions are not apparent in these black-and-white renderings.

Even in the black and white versions here, the capability of the system to quickly reveal go and no-go areas can be appreciated. In the lower left illustration, the heavier lines show the optimum routes selected by the system.

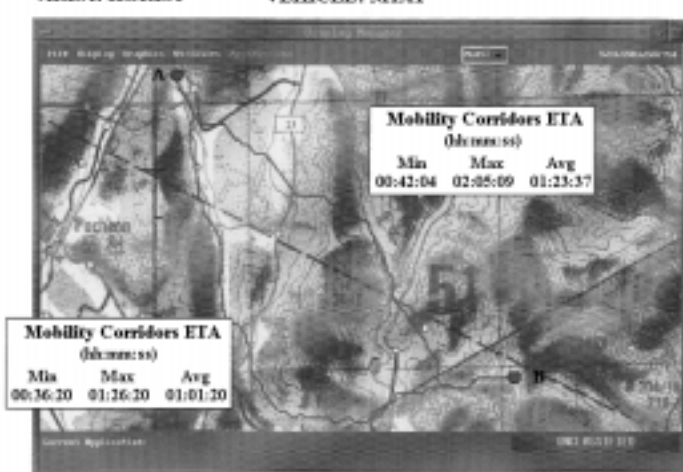
AREA: KOREA VEHICLE: M1A1



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Figure 2

AREA: KOREA VEHICLE: M1A1



Two routes from Point A to B showing ETA differences.

Figure 3

sates for heterogeneous soil composition as part of the mobility prediction algorithm. Through a series of tests comparing actual movement rates of vehicles and the predicted rate of movement, the differences are factored into the mobility predictions rendered by Risk Based Modeling. In addition, recent precipitation is accounted for in mobility predictions. The model adds further accuracy by allowing the user to consider subjective variables effecting mobility, such as the level of maintenance of the vehicle and the proficiency of the driver. If levels of maintenance and driver training can be generalized to a unit, an adjustment for unit movement times is possible. For example, we know that enemy vehicles are well maintained, but the training of enemy drivers is generally poor. Risk Based Mobility accounts for these conditions and allows differences in movement time based on variance in driver training and vehicle maintenance. Figure 3 identifies two routes from point A to B. The time of travel between these routes is given in minimum, maximum, and average time. A good driver in a well maintained vehicle will take the minimum time, an average driver will take the average time, and a poor driver the maximum time.

The most unique capability of Risk Based Modeling is its ability to predict random movement. This means the model can identify a range of possible routes for vehicles. Using Risk Based Modeling, a start point and an end point are selected for analysis. The model identifies possible routes between selected points for the type of vehicle indicated and specifies the time it will take for each route giving a best case, worst case, and average time. The routes identified in Figure 3 were identified by picking a start point and an end point. The model identifies routes and the minimum, maximum, and average time needed to traverse the routes.

To illustrate the utility of a mobility prediction tool at brigade, consider the following scenario. (Borrowed from Virtual Kyrgyzstan III, a JANUS exercise held at Ft. Knox to validate the concepts of ST 71-3, *Tactics, Techniques, and Procedures for The Digitized Brigade*.) The brigade was to attack an enemy mechanized division. The enemy division defended with two understrength brigades forward and a tank brigade situated to their rear (see Figure 4). The enemy tank brigade had dual missions of division reserve and

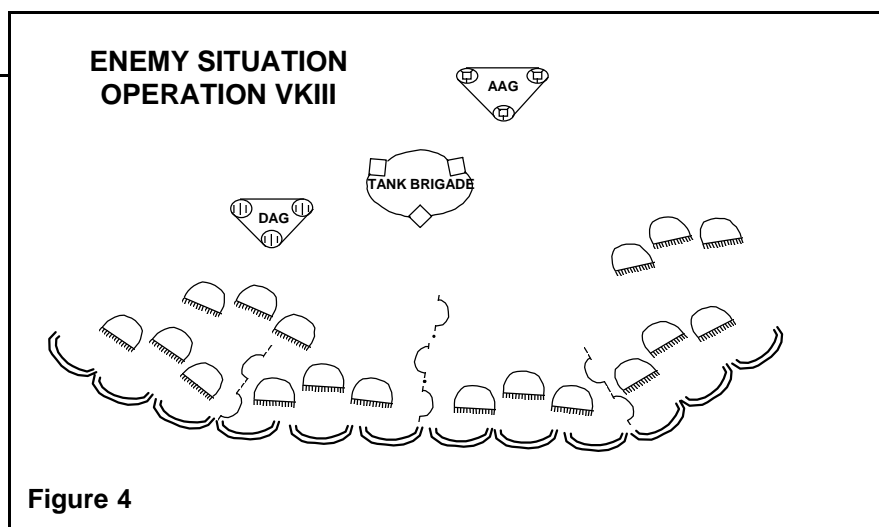


Figure 4

being lead element of a follow-on force when the enemy division resumed the offensive. The friendly brigade commander's plan called for destroying the enemy tank brigade and the division artillery group simultaneously. By attacking them simultaneously he could defeat both the enemy defense and the coming offensive operations. The friendly brigade commander's scheme of maneuver called for infiltrating subordinate mounted task forces through the enemy main defensive belt, then conducting a near simultaneous attack against the enemy tank brigade and the enemy division artillery group. An air assault task force would be inserted to the north between the enemy tank brigade and an artillery group present to support the future enemy offensive (see Figure 5). Due to the non-linear nature of the battlefield, the friendly brigade

commander directed his S2 to develop a graphic showing where and in what time frame the enemy tank brigade could move in any direction. Normally, the short time given to an S2 to develop this product demands that it be done in the TOC and involves the S2 guessing about the trafficability of the terrain, applying normal movement speeds for that type unit, and developing time phase lines to illustrate movement times (see Figure 6). The precision and reliability of this product is low. With a mobility prediction tool, like Risk Based Mobility Modeling, this product is at the S2's fingertips. By picking a series of start points and end points, as shown in Figure 3, the S2 can develop a product that provides a mobility estimate with much greater precision and speed than any manual product.

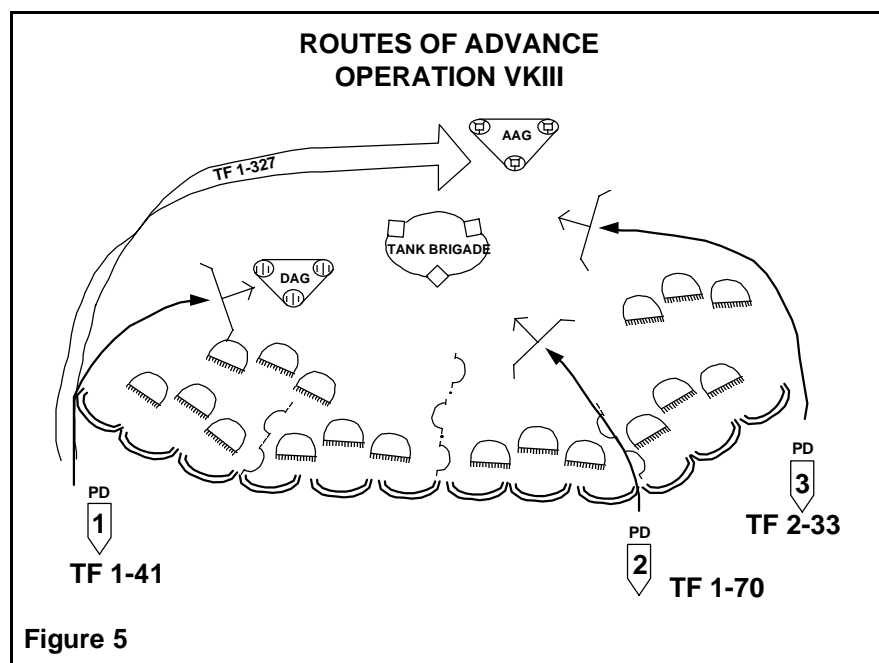
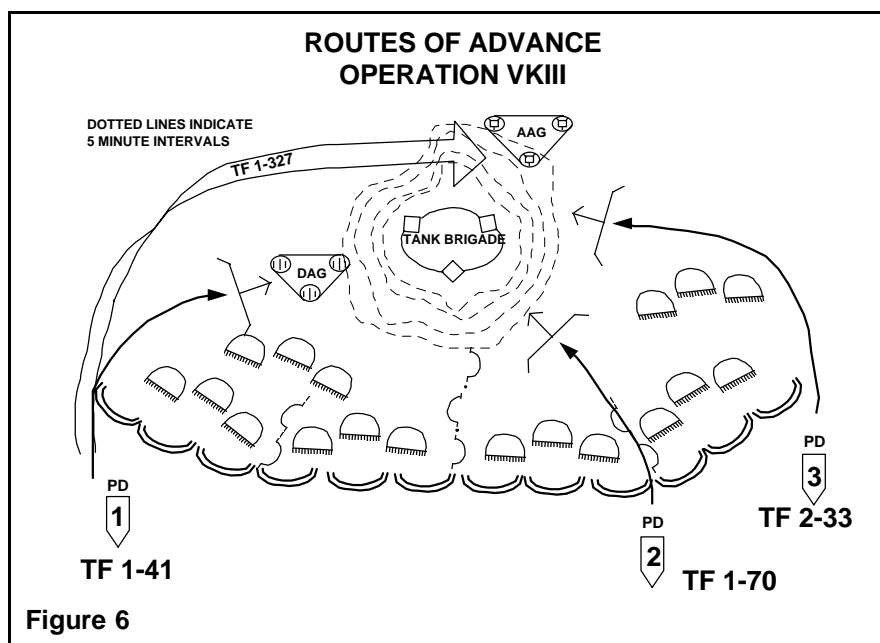


Figure 5



The application of mobility prediction software is not limited to intelligence. As part of the same scenario, the scheme of maneuver called for all the subordinate task forces to be in position to attack the enemy tank brigade and division artillery group in a near-simultaneous manner. During execution, the subordinate units crossed multiple points of departure at the same time. Resulting from inaccurate mobility predictions, the unit with the shortest distance to travel, TF 1-41, took the longest to get in position (see Figure 6). This was due to the nature of the terrain along his route. The soil was soft, resulting in slower movement. Because his movement lagged behind the other

task forces, the brigade plan had to be altered. Other units had to slow their movement and go into concealed positions to wait for the slow task force to get into position. This gave the enemy commander time to react. He dispersed the tank brigade into battalions and used them to counterattack (see Figure 7).

Using an automated mobility prediction tool with the capabilities of Risk Based Modeling, movement times are indicated on routes selected by the task forces. If a certain route is identified as unsuitable during analysis, an alternate can be chosen. With more precision in planning routes, and a better estimate

on movement times, the commander can sequence departure times for subordinate units allowing for the planned near-simultaneous attack against the enemy tank brigade and division artillery group.

This scenario highlights the utility and need for an automated mobility prediction tool, at least at the brigade level. The information requirements and high tempo of Force XXI operations demand a terrain visualization aid that can provide the commander accurate and useful mobility predictions. If resident at brigade level, this capability would provide the commander an invaluable decision-making aid with utility in both operations and intelligence, responsive to his needs before and during the battle.

During the Army's transition from an industrial age force to an information age force, we are providing brigade commanders the means to gain unprecedented situational awareness of the enemy and his own forces. To complete this, the commander needs a precision tool to help him understand the terrain on which he will fight. An automated mobility prediction application such as Risk Based Mobility Modeling provides this tool.

Captain Robert S. Mikaloff earned his commission in 1985 through Officer Candidate School. His previous assignments include assistant S3, 311th MI Battalion, 101st Airborne (AASLT); S2, 2/327th Infantry, 101st Airborne (AASLT); G2 ASPS Chief, 6th ID (L); company commander, HHSC, 106th MI Battalion; and instructor, Armor School. Recently, he served as the S2 Trainer at the Virtual Training Program, Ft. Knox. Currently, he is the USAARMC Threat manager and a member of the Advanced Warfighting Working Group.

The author would like to thank Dr. Niki C. Deliman of the U.S. Army Corps of Engineers Waterways Experiment Station for technical advice in the writing of this article.

